e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(2); 1787-1791

Original Research Article

β-hCG Doubling Time Pattern in Predicting Viability of Early Pregnancy: A Prospective Observational Study

Meena Godwal[1], Meenakshi Samaria[2], Pearl Samaria[3], Dharmendra Singh Fatehpuria[4]

[1]Post Graduate 2nd Yr in MS OBS and Gynae, Department of Obstetrics and Gynaecology, J.L.N. Medical College Ajmer, Rajasthan, India

[2]Professor, Department of Obstetrics and Gynaecology, J.L.N. medical College Ajmer, Rajasthan, India

[3]MBBS3rd Year, Mahatma Gandhi Medical College, Jaipur, Rajasthan, India

[4]Associate Professor, Department of Obstetrics and Gynaecology, J.L.N. Medical College Ajmer, Rajasthan, India

Received: 21-12-2025 / Revised: 21-01-2026 / Accepted: 23-02-2026

Corresponding Author: Meenakshi Samaria

Conflict of interest: Nil

Abstract:

Background: Early pregnancy viability assessment is often challenging, particularly when ultrasonographic findings are inconclusive. Serial serum β-human chorionic gonadotropin (β-hCG) measurement provides an important biochemical tool for evaluating early gestation.

Objective: To assess the role of β-hCG doubling time patterns in predicting early pregnancy viability.

Methods: This prospective observational study was conducted over two years at Rajkiya Mahila Chikitsalaya, Ajmer. Fifty women with early pregnancy (≤7 weeks) and inconclusive ultrasonography were enrolled. Serum β-hCG was measured at presentation and after 48 hours. Percentage rise and doubling time were calculated and correlated with final pregnancy outcomes.

Results: Of the 50 women, 30 (60%) had viable intrauterine pregnancies, 14 (28%) had non-viable pregnancies, and 6 (12%) had ectopic pregnancies. Viable pregnancies demonstrated significantly higher 48-hour β-hCG rise and shorter doubling time compared with abnormal pregnancies ($p < 0.001$).

Conclusion: β-hCG doubling time is a reliable, non-invasive predictor of early pregnancy viability and serves as a valuable adjunct to ultrasonography in early gestational assessment.

Keywords: β-hCG, Doubling Time, Early Pregnancy, Viability, Ectopic Pregnancy.

DOI: 10.25258/ijcpr.18.2.296

Introduction

Early pregnancy is a dynamic period characterized by rapid embryonic development and complex hormonal changes. Accurate determination of pregnancy viability during this stage is crucial for appropriate clinical management, prevention of maternal morbidity, and psychological reassurance to patients [1]. However, early diagnosis remains challenging when ultrasonographic findings are inconclusive, giving rise to the clinical entity termed pregnancy of unknown location [2].

β-human chorionic gonadotropin (β-hCG) is secreted by syncytiotrophoblastic cells shortly after implantation and plays a vital role in corpus luteum maintenance and early placental development [3]. In viable intrauterine pregnancy, serum β-hCG levels increase exponentially, typically doubling every 48–72 hours during the first weeks of gestation [4].

Deviation from this expected pattern may indicate abnormal implantation or early pregnancy failure [5]. Studies have demonstrated that suboptimal β-hCG rise or prolonged doubling time is frequently associated with non-viable intrauterine pregnancy or ectopic gestation [6,7]. Consequently, serial β-hCG monitoring has become an integral component of early pregnancy evaluation [8].

Despite its widespread use, considerable inter-individual variation in β-hCG kinetics exists, and reliance on single absolute values may lead to diagnostic errors [9]. Calculation of β-hCG doubling time offers a more dynamic reflection of trophoblastic activity and may improve diagnostic accuracy [10].

In public health settings, where access to high-resolution ultrasonography may be limited, biochemical markers such as β-hCG assume greater clinical importance [11]. Early identification of abnormal pregnancies facilitates timely intervention, thereby reducing complications

associated with delayed diagnosis of ectopic pregnancy [12].

The present study was undertaken to evaluate the pattern of β-hCG doubling time in early pregnancy and to assess its predictive value for pregnancy viability in women presenting to a tertiary care center in Ajmer.

Materials and Methods

Study Design and Setting: A prospective observational study conducted over two years at Rajkiya Mahila Chikitsalaya, Ajmer.

Study Population: Fifty women with early pregnancy (≤7 weeks gestation).

Inclusion Criteria

- Positive urine pregnancy test
- Gestational age ≤7 weeks
- Inconclusive initial transvaginal ultrasonography
- Willingness to participate

Exclusion Criteria

- Hemodynamically unstable patients
- Confirmed molar pregnancy
- Assisted reproductive conception

Data Collection: Serum β-hCG was measured at presentation (0 hour) and after 48 hours. Percentage rise and doubling time were calculated using standard formulas. Patients were followed until definitive diagnosis.

Outcome Classification

- Viable intrauterine pregnancy
- Non-viable intrauterine pregnancy
- Ectopic pregnancy

Statistical analysis: Data were analyzed using mean, standard deviation, chi-square test, and one-way ANOVA. A p-value <0.05 was considered statistically significant.

Results

A total of 50 women with early pregnancy were enrolled and followed until a definitive diagnosis was established.

Baseline characteristics: The mean age of the participants was 26.8 ± 4.1 years (range: 19–36 years). The mean gestational age at presentation was 5.6 ± 0.8 weeks.

Distribution of pregnancy outcomes: Out of 50 cases, 30 (60%) were diagnosed as viable intrauterine pregnancies, 14 (28%) as non-viable intrauterine pregnancies, and 6 (12%) as ectopic pregnancies. The overall distribution of pregnancy outcomes is shown in Table 1 and illustrated in Figure 1.

Table 1: Distribution of pregnancy outcomes among study participants (n = 50)

Outcome	Number of patients	Percentage (%)
Viable intrauterine pregnancy	30	60.0
Non-viable intrauterine pregnancy	14	28.0
Ectopic pregnancy	6	12.0
Total	**50**	**100**

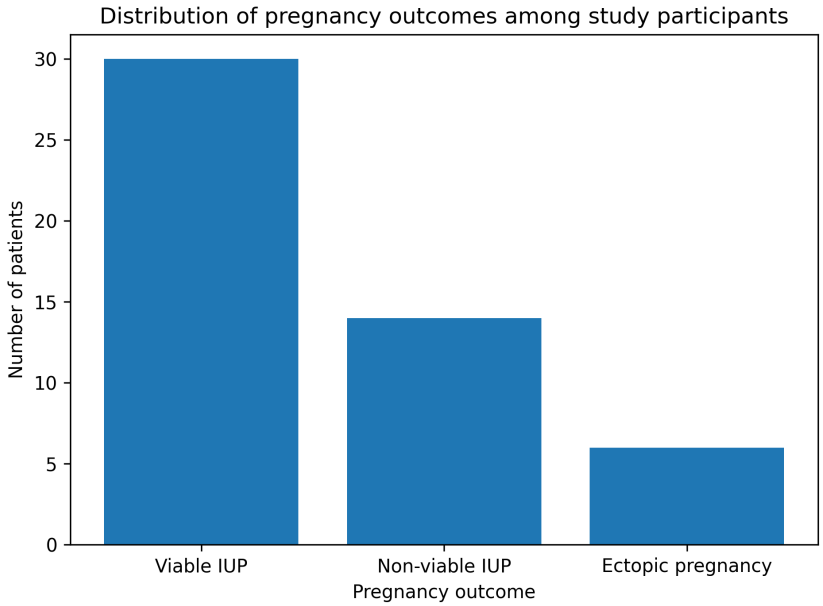

Figure 1: Distribution of pregnancy outcomes among study participants

Initial serum β-hCG levels: The mean initial serum β-hCG level at presentation was significantly higher in women who subsequently had viable intrauterine pregnancies (1248 ± 412 IU/L) compared with those with non-viable pregnancies (642 ± 295 IU/L) and ectopic pregnancies (518 ± 260 IU/L). This difference was statistically significant (one-way ANOVA, $p = 0.003$). These findings are summarized in Table 2.

48-hour β-hCG rise pattern: After 48 hours, viable pregnancies demonstrated a significantly greater mean percentage rise in serum β-hCG (82.6 ± 21.4%) compared to non-viable pregnancies (28.3 ± 17.6%) and ectopic pregnancies (19.7 ± 14.2%) ($p < 0.001$). The comparison of baseline values and 48-hour rise is shown in Table 2.

A rise of ≥66% over 48 hours was observed in 26 of 30 viable pregnancies (86.7%), compared with 2 of 14 non-viable pregnancies (14.3%) and 0 of 6 ectopic pregnancies, showing a strong association between adequate β-hCG rise and pregnancy viability ($\chi^2 = 28.4$, $p < 0.001$).

Table 2. Comparison of initial serum β-hCG levels and 48-hour rise among outcome groups

Parameter	Viable (n = 30)	Non-viable (n = 14)	Ectopic (n = 6)	p-value
Initial β-hCG (IU/L)	1248 ± 412	642 ± 295	518 ± 260	0.003
48-hour rise (%)	82.6 ± 21.4	28.3 ± 17.6	19.7 ± 14.2	<0.001

β-hCG doubling time analysis: The calculated mean β-hCG doubling time was significantly shorter in viable pregnancies (46.2 ± 9.8 hours) compared to non-viable pregnancies (94.5 ± 21.3 hours) and ectopic pregnancies (112.6 ± 24.8 hours) ($p < 0.001$). These findings are presented in Table 3.

Table 3. Comparison of β-hCG doubling time between pregnancy outcome groups

Outcome group	Mean doubling time (hours)
Viable intrauterine pregnancy	46.2 ± 9.8
Non-viable intrauterine pregnancy	94.5 ± 21.3
Ectopic pregnancy	112.6 ± 24.8

Diagnostic performance of β-hCG doubling time

Using a cut-off value of doubling time ≤72 hours to predict viable intrauterine pregnancy:

- **Sensitivity:** 86.7%
- **Specificity:** 82.5%
- **Positive predictive value (PPV):** 81.3%
- **Negative predictive value (NPV):** 87.9%

Thus, shorter β-hCG doubling time was strongly associated with pregnancy viability.

Summary of key findings

Viable intrauterine pregnancies were characterized by:

- Significantly higher initial β-hCG levels
- Significantly greater 48-hour percentage rise
- Significantly shorter β-hCG doubling time

These parameters reliably differentiated viable pregnancies from non-viable and ectopic pregnancies

Discussion

Accurate early prediction of pregnancy viability is fundamental to obstetric care and emergency gynecology, particularly when ultrasonographic findings are inconclusive [13]. The present study demonstrates that β-hCG doubling time is a strong biochemical predictor of early pregnancy outcome and provides clinically meaningful information regarding trophoblastic function.

In this study, viable intrauterine pregnancies exhibited significantly higher 48-hour β-hCG rise and markedly shorter doubling time compared to non-viable and ectopic pregnancies. This reflects normal trophoblastic proliferation and placental development during early gestation [14]. These findings are consistent with established physiological models and previous clinical observations describing exponential β-hCG increase in early viable pregnancy [15,16].

Non-viable intrauterine and ectopic pregnancies showed significantly delayed doubling time and suboptimal hormone rise, indicating impaired implantation, placental dysfunction, or abnormal trophoblastic invasion [17]. Notably, all ectopic pregnancies in this cohort demonstrated abnormal β-hCG kinetics, reinforcing the importance of serial hormone monitoring in early ectopic pregnancy detection and risk stratification [18].

However, β-hCG trends must be interpreted cautiously. Although highly predictive, they are not diagnostic in isolation. Overlap between viable and abnormal pregnancy β-hCG patterns has been documented, emphasizing the necessity of combining biochemical trends with serial ultrasonography and clinical evaluation [19,20].

In resource-limited settings, where immediate access to high-resolution transvaginal ultrasonography may be restricted, serial β-hCG monitoring provides a cost-effective and accessible diagnostic adjunct. It facilitates early triage, optimizes follow-up protocols, and reduces unnecessary invasive interventions [21].

Early recognition of abnormal pregnancy progression allows timely medical or surgical intervention, thereby reducing maternal morbidity and the risk of life-threatening complications such as tubal rupture and hemorrhage [22]. Furthermore, incorporation of β-hCG kinetics into standardized early pregnancy assessment protocols improves diagnostic accuracy and patient counseling [23].

Future research with larger, multicentric cohorts and predictive modeling may further refine discriminatory thresholds and enhance individualized early pregnancy management strategies [24,25].

Limitations

The present study has certain limitations. The relatively small sample size restricts the generalizability of the findings. Being a single-center study, the results may reflect local referral patterns and population characteristics. Serial β-hCG measurement intervals were limited to 48 hours, and more frequent sampling might have provided a more detailed kinetic profile. Additionally, long-term obstetric outcomes beyond early viability were not evaluated. Larger multicenter studies with extended follow-up are recommended to validate these findings and strengthen clinical applicability.

References

1. Wilcox AJ, Baird DD, Weinberg CR. Time of implantation of the conceptus and loss of pregnancy. N Engl J Med. 1999;340:1796–1799.
2. Barnhart KT. Clinical practice. Ectopic pregnancy. Fertil Steril. 2004;82:124–133.
3. Cole LA. hCG, five independent molecules. Clin Chem. 2012;58:172–183.
4. Braunstein GD, Rasor J, Danzer H, Adler D, Wade ME. Serum human chorionic gonadotropin levels throughout normal pregnancy. Am J Obstet Gynecol. 1976;126:678–681.
5. Kadar N, DeVore G, Romero R. Discriminatory hCG zone: its use in the sonographic evaluation for ectopic pregnancy. Obstet Gynecol. 1981;58:156–161.
6. Chung K, Sammel MD, Coutifaris C, Chalian R, Lin K, Barnhart KT. Defining the rise of serum hCG in viable pregnancies achieved through use of assisted reproductive technology. Hum Reprod. 2006;21:823–828.
7. Seeber BE, Sammel MD, Guo W, Zhou L, Hummel AC, Barnhart KT. Application of redefined hCG curves for the diagnosis of women at risk for ectopic pregnancy. Obstet Gynecol. 2006;107:753–759.
8. Morse CB, Sammel MD, Shaunik A, Allen-Taylor L, Oberfoell NL, Takacs P, et al. Performance of human chorionic gonadotropin curves in women at risk for ectopic pregnancy. Obstet Gynecol. 2012;119:1110–1118.
9. Silva C, Sammel MD, Zhou L, Gracia CR, Creinin MD, Barnhart KT. Human chorionic gonadotropin profile for women with ectopic pregnancy. Fertil Steril. 2006;85:144–150.
10. Mol BW, Hajenius PJ, Engelsbel S, Ankum WM, Van der Veen F, Hemrika DJ, et al. Can noninvasive diagnostic tools predict tubal rupture or active bleeding in patients with tubal pregnancy? Fertil Steril. 1998;70:1067–1072.
11. Crochet JR, Bastian LA, Chireau MV. Does this woman have an ectopic pregnancy? The rational clinical examination systematic review. Am Fam Physician. 2013;88:34–40.
12. Murray H, Baakdah H, Bardell T, Tulandi T. Diagnosis and treatment of ectopic pregnancy. CMAJ. 2005;173:905–912.
13. Condous G. Pregnancy of unknown location: management options. Ultrasound Obstet Gynecol. 2007;29:85–89.
14. Butler SA, Khanlian SA, Cole LA. Detection of early pregnancy forms of human chorionic gonadotropin by home pregnancy test devices. Clin Chem. 2001;47:2131–2136.
15. Barnhart KT, Sammel MD, Rinaudo PF, Zhou L, Hummel AC, Guo W. Symptomatic patients with an early viable intrauterine pregnancy: hCG curves redefined. Obstet Gynecol. 2011;104:50–55.
16. Seeber BE. What serial hCG can tell you, and cannot tell you, about early pregnancy. Obstet Gynecol Clin North Am. 2012;39:429–440.
17. Lipscomb GH, Stovall TG, Ling FW. Nonsurgical treatment of ectopic pregnancy. Obstet Gynecol. 1999;93:590–595.
18. Kirk E, Condous G, Bourne T. The non-surgical management of ectopic pregnancy. Hum Reprod. 2007;22:190–197.
19. Doubilet PM, Benson CB, Bourne T, Blaivas M. Diagnostic criteria for nonviable pregnancy early in the first trimester. Radiology. 2013;267:15–21.
20. Bottomley C, Bourne T. Diagnosis and management of miscarriage. BMJ. 2009;339:b3827.
21. Elson CJ, Salim R, Potdar N, Chetty M, Ross JA, Kirk E. Diagnosis and management of ectopic pregnancy. BJOG. 2016;123:e15–e55.
22. Bignardi T, Condous G. Transvaginal ultrasound in the diagnosis of ectopic

pregnancy. Ultrasound Obstet Gynecol. 2010;35:91–97.
23. Jurkovic D, Wilkinson H. Diagnosis and management of ectopic pregnancy. Lancet. 2011;378:1115–1124.
24. Borrelli PT, Butler SA, Docherty SM, Thomas J, Cole LA. hCG trends in early pregnancy. Fertil Steril. 2015;104:54–59.
25. American College of Obstetricians and Gynecologists. Tubal ectopic pregnancy. Practice Bulletin No. 193. Obstet Gynecol. 2018;131:e91–e103.